

# SE556, SE556C, SA556, NE556 DUAL PRECISION TIMERS

D2440, APRIL 1978—REVISED OCTOBER 1988

- Two Precision Timing Circuits per Package
- Astable or Monostable Operation
- TTL-Compatible Output Can Sink or Source Up to 150 mA
- Active Pull-Up or Pull-Down
- Designed to be Interchangeable with Signetics SE556, SE556C, SA556, NE556

## APPLICATIONS

|   |                                     |
|---|-------------------------------------|
| Precision Timer from<br>Microseconds to Hours | Sequential Timer<br>Pulse Generator |
| Pulse-Shaping Circuit                         | Time-Delay Circuit                  |
| Missing-Pulse Detector                        | Frequency Divider                   |
| Tone-Burst Generator                          | Appliance Timer                     |
| Pulse-Width Modulator                         | Industrial Controls                 |
| Pulse-Position Modulator                      | Touch-Tone Encoder                  |

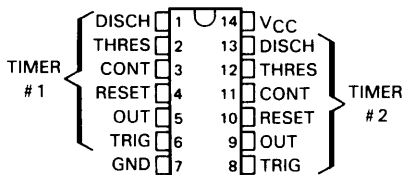
## SE556C FROM TI IS NOT RECOMMENDED FOR NEW DESIGNS

### description

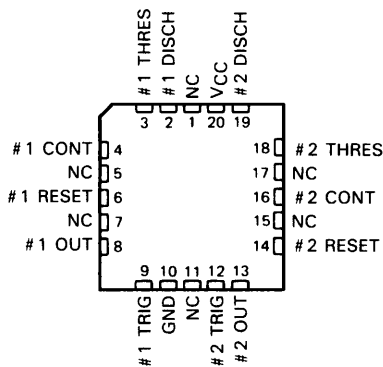
These devices provide two monolithic, independent timing circuits of the SE555, SE555C, SA555, or NE555 type in each package. These circuits can be operated in the astable or the monostable mode with external resistor-capacitor timing control. The basic timing provided by the RC time constant may be actively controlled by modulating the bias of the control voltage input.

The threshold and trigger levels are normally two-thirds and one-third respectively of  $V_{CC}$ . These levels can be altered by use of the control voltage terminal. When the trigger input falls below trigger level, the flip-flop is set and the output goes high. If the trigger input is above the trigger level and the threshold input is above the threshold level, the flip-flop is reset and the output is low. The reset input can override all other inputs and can be used to initiate a new timing cycle. When the reset input goes low, the flip-flop is reset and the output goes low. Whenever the output is low, a low impedance path is provided between the discharge terminal and ground.

SE556, SE556C . . . J PACKAGE  
SA556, NE556 . . . D, J, OR N PACKAGE  
(TOP VIEW)

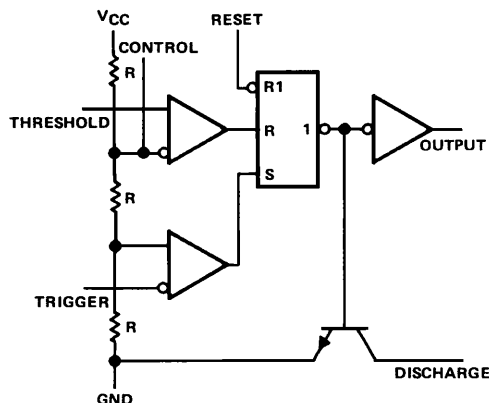


SE556, SE556C . . . FK PACKAGE  
(TOP VIEW)



NC—No internal connection

### functional block diagram (each timer)



Reset can override Trigger, which can override Threshold.

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Special Functions

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The SE556 and SE556C are characterized for operation over the full military range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SA556 is characterized for operation from  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , and the NE556 is characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

AVAILABLE OPTIONS

| T <sub>A</sub><br>RANGE | V <sub>thres</sub> MAX<br>V <sub>CC</sub> = 15 V | PACKAGE                 |                         |                       |                       |
|-------------------------|--|-------------------------|-------------------------|-----------------------|-----------------------|
|                         |  | SMALL<br>OUTLINE<br>(D) | CHIP<br>CARRIER<br>(FK) | CERAMIC<br>DIP<br>(J) | PLASTIC<br>DIP<br>(N) |
| 0°C<br>to<br>70°C       | 11.2 V   | NE556D                  |                         | NE556J                | NE556N                |
| -40°C<br>to<br>85°C     | 11.2 V   | SA556D                  |                         | SA556J                | SA556N                |
| -55°C<br>to<br>125°C    | 10.6 V<br>11.2 V                                 |                         | SE556FK<br>SE556CFK     | SE556J<br>SE556CJ     |                       |

The D package is available taped and reeled. Add the suffix R to the device type (e.g., NE556DR).

FUNCTION TABLE

| RESET | TRIGGER<br>VOLTAGE†   | THRESHOLD<br>VOLTAGE† | OUTPUT                    | DISCHARGE<br>SWITCH |
|-------|-----------------------|-----------------------|---------------------------|---------------------|
| Low   | Irrelevant            | Irrelevant            | Low                       | On                  |
| High  | < 1/3 V <sub>DD</sub> | Irrelevant            | High                      | Off                 |
| High  | > 1/3 V <sub>DD</sub> | > 2/3 V <sub>DD</sub> | Low                       | On                  |
| High  | > 1/3 V <sub>DD</sub> | < 2/3 V <sub>DD</sub> | As previously established |                     |

†Voltage levels shown are nominal.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|  |                              |
|--|------------------------------|
| Supply voltage, V <sub>CC</sub> (See Note 1)                                 | 18 V                         |
| Input voltage (control, reset, threshold, and trigger)                       | V <sub>CC</sub>              |
| Output current   | ±225 mA                      |
| Continuous total dissipation   | see Dissipation Rating Table |
| Operating free-air temperature range: SE556, SE556C                          | -55°C to 125°C               |
| SA556  | -40°C to 85°C                |
| NE556  | 0°C to 70°C                  |
| Storage temperature range  | -65°C to 150°C               |
| Case temperature for 60 seconds: FK package                                  | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: J package      | 300°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or N package | 260°C                        |

NOTE 1: All voltage values are with respect to network ground terminal.

DISSIPATION RATING TABLE

| PACKAGE           | T <sub>A</sub> ≤ 25°C | DERATING<br>FACTOR          | T <sub>A</sub> = 70°C | T <sub>A</sub> = 85°C | T <sub>A</sub> = 125°C |
|-------------------|-----------------------|-----------------------------|-----------------------|-----------------------|------------------------|
|                   | POWER RATING          | ABOVE T <sub>A</sub> = 25°C | POWER RATING          | POWER RATING          | POWER RATING           |
| D                 | 950 mW                | 7.6 mW/°C                   | 608 mW                | 494 mW                | N/A                    |
| FK                | 1375 mW               | 11.0 mW/°C                  | 880 mW                | 715 mW                | 275 mW                 |
| J (SE556, SE556C) | 1375 mW               | 11.0 mW/°C                  | 880 mW                | 715 mW                | 275 mW                 |
| J (SA556, NE556)  | 1025 mW               | 8.2 mW/°C                   | 656 mW                | 533 mW                | N/A                    |
| N                 | 1575 mW               | 12.6 mW/°C                  | 1008 mW               | 819 mW                | N/A                    |

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## recommended operating conditions

|  | SE556     |     | SE556C    |     | SA556     |     | NE556     |     | UNIT               |
|--|-----------|-----|-----------|-----|-----------|-----|-----------|-----|--------------------|
|  | MIN       | MAX | MIN       | MAX | MIN       | MAX | MIN       | MAX |                    |
| Supply voltage, $V_{CC}$                               | 4.5       | 18  | 4.5       | 16  | 4.5       | 16  | 4.5       | 16  | V                  |
| Input voltage (control, reset, threshold, and trigger) | $V_{CC}$  |     | $V_{CC}$  |     | $V_{CC}$  |     | $V_{CC}$  |     | V                  |
| Output current   | $\pm 200$ |     | $\pm 200$ |     | $\pm 200$ |     | $\pm 200$ |     | mA                 |
| Operating free-air temperature, $T_A$                  | -55       | 125 | -55       | 125 | -40       | 85  | 0         | 70  | $^{\circ}\text{C}$ |

## electrical characteristics at 25 $^{\circ}\text{C}$ free-air temperature, $V_{CC} = 5\text{ V}$ to 15 V (unless otherwise noted)

| PARAMETER                          | TEST CONDITIONS        |                           | SE556 |      |      | SE556C, SA556, NE556 |      |               | UNIT |
|------------------------------------|------------------------|---------------------------|-------|------|------|----------------------|------|---------------|------|
|                                    |                        |                           | MIN   | TYP  | MAX  | MIN                  | TYP  | MAX           |      |
| Threshold voltage level            | $V_{CC} = 15\text{ V}$ |                           | 9.4   | 10   | 10.6 | 8.8                  | 10   | 11.2          | V    |
|                                    | $V_{CC} = 5\text{ V}$  |                           | 2.7   | 3.3  | 4    | 2.4                  | 3.3  | 4.2           |      |
| Threshold current (see Note 2)     |                        |                           | 30    | 250  |      | 30                   | 250  | nA            |      |
| Trigger voltage level              | $V_{CC} = 15\text{ V}$ |                           | 4.8   | 5    | 5.2  | 4.5                  | 5    | 5.6           | V    |
|                                    | $V_{CC} = 5\text{ V}$  |                           | 1.45  | 1.67 | 1.9  | 1.1                  | 1.67 | 2.2           |      |
| Trigger current                    | Trigger at 0 V         |                           | 0.5   | 0.9  |      | 0.5                  | 2    | $\mu\text{A}$ |      |
| Reset voltage level                |                        |                           | 0.3   | 0.7  | 1    | 0.3                  | 0.7  | 1             | V    |
| Reset current                      | Reset at $V_{CC}$      |                           | 0.1   | 0.4  |      | 0.1                  | 0.4  | mA            |      |
|                                    | Reset at 0 V           |                           | -0.4  | -1   |      | -0.4                 | -1.5 |               |      |
| Discharge switch off-state current |                        |                           | 20    | 100  |      | 20                   | 100  | nA            |      |
| Control voltage (open circuit)     | $V_{CC} = 15\text{ V}$ |                           | 9.6   | 10   | 10.4 | 9                    | 10   | 11            | V    |
|                                    | $V_{CC} = 5\text{ V}$  |                           | 2.9   | 3.3  | 3.8  | 2.6                  | 3.3  | 4             |      |
| Low-level output voltage           | $V_{CC} = 15\text{ V}$ | $I_{OL} = 10\text{ mA}$   | 0.1   | 0.15 |      | 0.1                  | 0.25 | V             |      |
|                                    |                        | $I_{OL} = 50\text{ mA}$   | 0.4   | 0.5  |      | 0.4                  | 0.75 |               |      |
|                                    |                        | $I_{OL} = 100\text{ mA}$  | 2     | 2.2  |      | 2                    | 2.5  |               |      |
|                                    |                        | $I_{OL} = 200\text{ mA}$  | 2.5   |      |      | 2.5                  |      |               |      |
|                                    | $V_{CC} = 5\text{ V}$  | $I_{OL} = 5\text{ mA}$    | 0.1   | 0.15 |      | 0.1                  | 0.25 |               |      |
|                                    |                        | $I_{OL} = 8\text{ mA}$    | 0.15  | 0.25 |      | 0.15                 | 0.3  |               |      |
| High-level output voltage          | $V_{CC} = 15\text{ V}$ | $I_{OH} = -100\text{ mA}$ | 13    | 13.3 |      | 12.75                | 13.3 | V             |      |
|                                    |                        | $I_{OH} = -200\text{ mA}$ |       | 12.5 |      | 12.5                 |      |               |      |
|                                    | $V_{CC} = 5\text{ V}$  | $I_{OH} = -100\text{ mA}$ | 3     | 3.3  |      | 2.75                 | 3.3  |               |      |
| Supply current                     | Output low, No load    | $V_{CC} = 15\text{ V}$    | 20    | 24   |      | 20                   | 30   | mA            |      |
|                                    |                        | $V_{CC} = 5\text{ V}$     | 6     | 10   |      | 6                    | 12   |               |      |
|                                    | Output high, No load   | $V_{CC} = 15\text{ V}$    | 18    | 20   |      | 18                   | 26   |               |      |
|                                    |                        | $V_{CC} = 5\text{ V}$     | 4     | 8    |      | 4                    | 10   |               |      |

NOTE 2: This parameter influences the maximum value of the timing resistors  $R_A$  and  $R_B$  in the circuit of Figure 1. For example, when  $V_{CC} = 5\text{ V}$ , the maximum value is  $R = R_A + R_B \approx 3.4\text{ M}\Omega$ , and for  $V_{CC} = 15\text{ V}$ , the maximum value is  $\approx 10\text{ M}\Omega$ .

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operating characteristics,  $V_{CC} = 5\text{ V}$  and  $15\text{ V}$

| PARAMETER                                     |                                     | TEST CONDITIONS <sup>†</sup>                               | SE556     |     |           | SE556C, SA556, NE556 |                       |     | UNIT |
|---|-------------------------------------|--|-----------|-----|-----------|----------------------|-----------------------|-----|------|
|   |                                     |  | MIN       | TYP | MAX       | MIN                  | TYP                   | MAX |      |
| Initial error of timing interval <sup>‡</sup> | Each timer, monostable <sup>§</sup> | $T_A = 25\text{ }^\circ\text{C}$                           | 0.5       | 1.5 |           | 1                    | 3                     | %   |      |
|   | Each timer, astable <sup>¶</sup>    |  | 1.5       |     | 2.25      |                      |                       |     |      |
|   | Timer 1 – Timer 2                   |  | $\pm 0.5$ |     | $\pm 1$   |                      |                       |     |      |
| Temperature coefficient of timing interval    | Each timer, monostable <sup>§</sup> | $T_A = \text{MIN to MAX}$                                  | 30        | 100 |           | 50                   | ppm/ $^\circ\text{C}$ |     |      |
|   | Each timer, astable <sup>¶</sup>    |  | 90        |     | 150       |                      |                       |     |      |
|   | Timer 1 – Timer 2                   |  | $\pm 10$  |     | $\pm 10$  |                      |                       |     |      |
| Supply voltage sensitivity of timing interval | Each timer, monostable <sup>§</sup> | $T_A = 25\text{ }^\circ\text{C}$                           | 0.05      | 0.2 |           | 0.1                  | 0.5                   | %/V |      |
|   | Each timer, astable <sup>¶</sup>    |  | 0.15      |     | 0.3       |                      |                       |     |      |
|   | Timer 1 – Timer 2                   |  | $\pm 0.1$ |     | $\pm 0.2$ |                      |                       |     |      |
| Output pulse rise time                        |                                     | $C_L = 15\text{ pF}$ ,<br>$T_A = 25\text{ }^\circ\text{C}$ | 100       | 200 |           | 100                  | 300                   | ns  |      |
| Output pulse fall time                        |                                     |  | 100       | 200 |           | 100                  | 300                   |     |      |

<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

<sup>‡</sup>Timing interval error is defined as the difference between the measured value and the average value of a random sample from each process run.

<sup>§</sup>Values specified are for a device in a monostable circuit similar to Figure 2, with component values as follow:  $R_A = 2\text{ k}\Omega$  to  $100\text{ k}\Omega$ ,  $C = 0.1\text{ }\mu\text{F}$ .

<sup>¶</sup>Values specified are for a device in an astable circuit similar to Figure 1, with component values as follow:  $R_A = 1\text{ k}\Omega$  to  $100\text{ k}\Omega$ ,  $C = 0.1\text{ }\mu\text{F}$ .

## TYPICAL APPLICATION DATA

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Special Functions

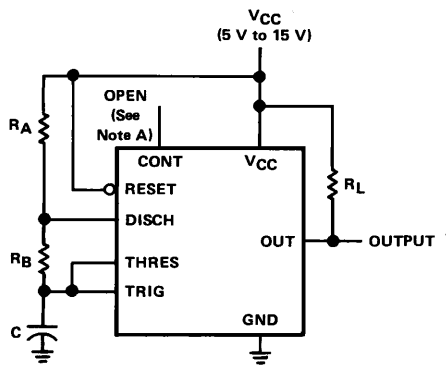


FIGURE 1. CIRCUIT FOR ASTABLE OPERATION

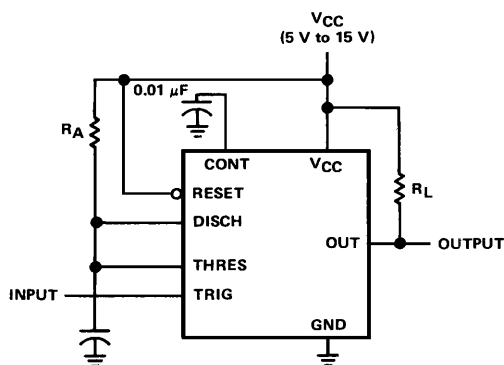


FIGURE 2. CIRCUIT FOR MONOSTABLE OPERATION

NOTE A: Bypassing the control voltage input to ground with a capacitor may improve operation. This should be evaluated for individual applications.